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Environmental Impact of Attitudinal Change towards Forest Conservation in Nigeria

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Abstract:
Nigeria is rich in tropical hardwood, most of which comes from the rainforest belt of the country. Nowadays, trees are felled indiscriminately in forests set aside by government as reserves, as well as in open forests. This study, therefore, examined the environmental effects of deforestation for immediate socio-economic satisfaction. Data were collected from both direct field observation (DFO), Landsat remote sensing and questionnaire administration at various locations within the forest regions. The study reveals that environmental impact is most severe on the northern verge of the forest belt where charcoal production has led to the disappearance of many species of valuable hardwoods resulting in savanna encroachment, migration of wild animals as well as high rate of nomadic in-migration to the area. Hardwoods that are resistant to drought are preferred by the charcoal producers. Gradual extinction of these trees brings about increase in run off, erosion and desertification. Recommendation was made for sustainable use of our natural vegetation by keeping sufficient trees for future need, and also to safeguard our soils and rivers.
Keywords: Rainforest, environment, deforestation, sustainable, hardwood.

INTRODUCTION

The forests and woodlands of Africa are important to man in several ways. They supply a number of useful wild products like honey, gums and fibers that are collected for home use or for sale. The forests also provide timber that are cut to make planks, plywood and furniture as well as protecting the soil from erosion [1]. The branches and leaves of trees help to break the force of the falling rain and promote percolation especially in regions where the rainfall is heavy and torrential in nature.

The tropical rainforest is the most diverse ecosystem in the world, yet it is also the most fragile [2]. This stems from the fact that conditions of temperature and humidity are so constant that species here specialize to a great extent. Their food sources are limited to only a few species. Thus when this biome is subjected to stress by human activity it often fails to return to the original state.

The rain forests in Nigeria are disappearing at alarming rate [3] and the 'green jungles' are constantly becoming grassland and grazing fields. The loss of rainforests is up to 20km^2 per annum. If left unchecked, it is estimated that by 2050 it is possible that there will be no extensive trace of primary tropical rainforest, but simply isolated of a few tens of square metres.

Although about 20 percent of the land area of Nigeria was earmarked as Forest Reserve, most of this nowadays consists of open woodland and only about 5 percent carries true high forest. A high percentage of Nigerian forests are cleared yearly for a variety of purposes ranging from timber production, construction, agriculture as well as charcoal production [4].

The original rain forest covered southern Nigeria, just above the mangrove forest that border the Atlantic coastlines. This zone has high temperatures and high relative humidity, and an annual rainfall of about 1500mm-2500mm. Many kinds of trees grow to various height in the rain forest belt [5]. Some of the giant trees attain heights of up to 45 metres. They include Iroko, Mahogany, African walnut, and Obeche. Forestry is generally of very little importance in northern Nigeria, as large part of the region are too dry for trees to grow well.

The root economy of the rain forest is agriculture. The fertility of the land is maintained by the degree of agricultural population pressure. Recently however, apart from the 'slash and burn' practice among the peasant farmers, indiscriminate felling of trees for timber and charcoal is now very rampant in the rainforest belt. This has led to the incursion into, and destruction of the forest reserves set aside by the various state governments.

In the process of creating development, the cultured human being has turned out to be the most dynamic agent of transformation and destruction of the environment [6]. And since all development is targeted at people, human beings are also the main beneficiary of the products obtained from the exploitation of the environment. It is of course the

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growing demand for resources by an ever-increasing population that has created the age-long concern over the state of the environment and the adequacies of resources for future generation

Living things, including human beings impact upon or modify the environments where they live, just as the environment impacts on living things. There is no problem in this relationship for as long as the total ecosystem made up of a great variety of species remains balanced, such that no organism is able to cause excessive damage to the environment. Trouble starts when nature's balance is upset by dominant species; usually the human population.

A crisis situation exists whenever and wherever human impact poses a threat to the existence of one or more species, or even to human beings themselves. There is therefore a growing realization that the modes of production, processing, distribution and consumption that prevail and are the most profitable in the short to medium term are not necessarily the healthiest or the most environmentally suitable [7].

MATERIALS AND METHODS

This study set out to examine the consequences of the recent change of attitude from forest conservation to wanton destruction of the rainforest for immediate satisfaction. This research work was carried out in the rainforest belt of the southwestern Nigeria (Figure 1).

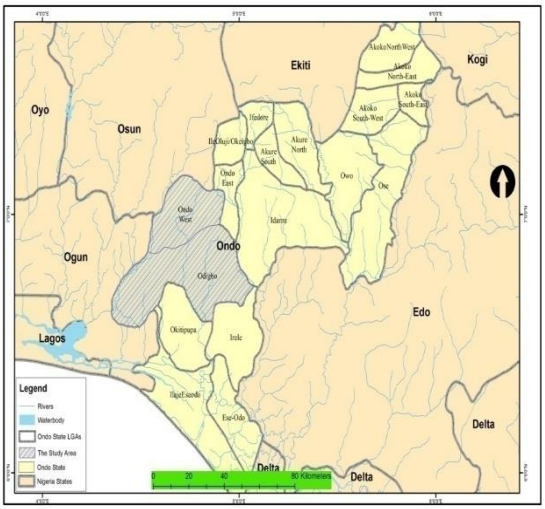

Fig. 1. Major Forest Reserve in Southwestern Nigeria

Direct field observation (DFO) through frequent visits to the forest reserves was employed. Data collection was carried out in two phases; the reconnaissance and detailed field work. The first phase involved periodic visits to the rainforest belt and relevant government agencies, including the Ministry of Agriculture and Forestry, in charge of protecting the forest reserves.

Land use and land cover change between 1996 and 2016 was examined based on the data generated through remote sensing Landsat. The outcome provides a first pointer to the pattern of change for the entire ecosystem of the study area. Multi temporal land use and land cover change analysis yield results that were used as proxy data for ecosystem service assessment across the static years. The outcome of the comparative ecosystem service valuation and assessment for the period considered generated another pointer for the explanation of the changes in ecosystem and the implication of such changes were discussed. This was further used as input for the ecosystem sensitivity analysis. Pattern and direction of ecosystem sensitivity analysis and change were used to further explain the observed forest ecosystem scenario in the study area.

Tree enumeration was carried out in forests around selected flash points of massive deforestation as well as production sites of charcoal to access the impact of the enterprise on the population of tree species. The observed changes were analysed using inferential statistics. Mean Change Indices (MCI) of preferred trees, was also carried out to ascertain the tree species at most risk of extinction from the forests.

The second phase of data collection for this research involved in-depth interviews through the administration of a structured questionnaire that focused on the reasons for the change of attitude of people towards tree conservation as well as the level of awareness of the implications of deforestation among dwellers of various villages around forest reserves. Samples of respondents were drawn from twelve randomly selected villages in three states (Ondo, Ogun and Oyo), within the rainforest belt of the southwestern Nigeria. In light of the apparent complex nature of causes and effects of deforestation, inhabitants of adjoining downstream settlements were also interviewed on their perception of the impact of deforestation on the built-up urban environment.

Data from both the field survey and the questionnaire administration were analyzed using

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relevant statistical methods including inferential and descriptive statistics like frequency count, mean, mode, sum and total and cartograms. These helped in summarizing the data as well as depicting trends in the data, thereby serving as explanatory tools.

RESULTS AND DISCUSSIONS

Deforestation is obvious where land has been cleared to extend the area under cultivation and in the surrounds of urban areas where trees are stripped for firewood, or charcoal production. Where this forest has been cut are often some of the most populous and developed parts of Nigeria especially the Southwest. The cost of the loss of vegetation cover cannot be adequately quantified but these can only be estimated.

Estimation of Changes in Ecosystem Function

In the south-western part of Nigeria and the Oluwa forest area of Ondo State in particular, land resources specifically forestlands are changing at a rapid rate. The forest ecosystems on which the residents of this area depend are showing sundry cryptograms of ecological pressure. These have been attributed to human demands for space particularly for agriculture which is usually small-scale and rain-dependent, urban expansion, township development, and due to government policy of state creation and establishment of large-scale projects which often leads to forestland conversion to other purposes [8].

Principal to the estimation of the total ecosystem value within a particular area is the identification of the constituent functions that aggregate at the level of ecosystem service. Thus, ecosystem function is spatially defined as a subset of universal ecosystem service [9]. It is essential to delimit the specific contribution of these ecosystem functions to the sustenance of the entire ecological life of a forest reserve area. Expectedly, these services were screened based on the land use and land cover for a period of 20 years (1996-2016). The estimated Ecosystem Service Value (ESV) is defined by the particular ecosystem function (*f*). Also, the estimated ESV were ranked hierarchically in order to define the most crucial ecosystem function in the study area and to understand the implication of any change to the entire environmental functionality and outlook particularly towards emerging environmental issues of climate change, carbon footprint, ecological change, and others.

The estimated value of all the identified ecosystem function for the base year 1996 is about $2,326.44million. 21.99% of this value is traceable to nutrient cycling which ranks highest with value of $511.58 million. This is followed by waste treatment (16.63%), disturbance regulation (15.71%), water supply (13.49%), raw materials (7.88%) erosion control (5.88%), and climate regulation (5.32%).Generic resources, water regulation, gas regulation, soil formation, pollination and biological control contributes less than 1% to the total ecosystem service depicting minimal contributions to the ecosystem functionalities thus rank the least of the ecosystem functions of the distribution of the ESV across the study area.

By 2006, the proportion, direction and extent of ecosystem function had changed. During this period, disturbance regulation ranks the highest with contribution of 22.28% to the total ecosystem functions in the area. The other top ranked functions that contributed immensely during the year include waste treatment (21.80%), water supply (18.75%), nutrient cycling (12.38%), raw materials (4.75%), cultural (4.34%), and recreation functions (4.32%). Minimal ecosystem function contributions can be traced to gas regulation (0.66%), generic resources (0.55%), water regulation (0.28), soil formation (0.14%), pollination (0.05%), and biological control (0.05%) which contributes at less than 1% to the total value. However, the total ecosystem function value at the year 2006 was estimated at about US $3158.35 million. This represents 35.76% increase within the period of 16 years indicating an improvement in the economic value of the ecosystem function for the area. The distribution of the ESV for this period across the landscape of the study area.

The estimated ecosystem function outlook for the concluding year 2016 showed a strident decline compared to the values of the previous years. The estimated ESV plummeted ecosystem to US$1,941.92 million a reduction of 62.64% within the temporal interval of 10 years. This shows the extent of decline in ecosystem functions in the Oluwa Forest Reserve area. Despite this decline, nutrient cycling (28.95%) contributes the highest ecosystem function in the study area. other ecosystem functions with high percentage of contribution and high rank include raw materials (12.94%), disturbance regulation (11.05%), raw materials (10.15%), water supply (9.67%), erosion control (7.72%), climate regulation (7.00%), and recreation. Gas regulation

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(0.33%), soil formation (0.32%), pollination (0.03%), and biological control (0.02%) contribute the least respectively. Thus, the ecosystem function of the Oluwa Forest Reserve area becomes stressed owing to the respective changes in the constituent's factors defining the extent of ecosystem service functions. The estimates therefore indicate a stressing as defined by the ecological changes thus, a reduction in the valuation of the functions.

Overall, the distribution of the ecosystem function shows a quasi-even distribution in which the top ranked functions shared somewhat similar values. Although the contribution of nutrient cycling to total value of ecosystem services declines over the 20 years period, it continues to be the dominant ecosystem function, contributing about 34%. Waste treatment, disturbance regulation, water supply, raw materials, erosion control, climate regulation, cultural, recreation, food production and habitat each contributed an average of more than 1% to the value of total ecosystem services, while the contribution of other ecosystem functions was minimal. Among the 10 top ranked ecosystem functions, the contribution of water regulation, water supply, waste treatment, and raw materials increased substantially over the 20-year coverage of the study, while the contribution of cultural, food production, climate regulation, habitat and generic resources decreased substantially during the same period. This scenario therefore makes it imperative to investigate further the aggregate ecosystem service vis-à-vis the recorded changes in land use and land cover.

Three major ecosystem components within the period 1996–2016 recorded losses. Wetland ecosystem recorded a loss of US $1595.90 million, which corresponds to an acreage loss of 107,940.28 ha. Reserve forest ecosystem service shrink to a value of US$ 125.36 million, which is analogous to spatio-temporal land use and land cover loss of 62,461.08 ha. And, riparian forest ecology reduced by a land area of 42,700.95 which corresponds to US $9.91 million with annual service value loss of US $1.24 million.

Forest ecology recorded improvements in service value, which amounts to US $497.86 million with annual average of US $62.23 million. This increase corresponds to acreage increase in land area of about 248,062.05 ha. Overall, this development leading to decrease in the sum of ESV in the study thus reducing the quality of ecosystem service and respective function. Simply, the increase in the economic value of the riparian ecosystem did not produce a similar increase in the total economic value of the entire ecosystem as other key ecosystem recorded losses during the period.

Factors Influencing Recent Incursion into Forest Reserves

Although about 75 percent of the people of the forest belt depend upon agriculture for their living, only about 10 percent of the land in the northern edge of the rainforest is used for growing tree crops. About 40 percent of the total land surface is now used to pasture livestock. The cultivated land in the area consist of subsistence farming of arable crops which are less protective of the soils.

Poverty is one of the main factors cited for the high rate of forest depletion in Nigeria as many households depend on wood for their domestic energy supply. Large scale rural-urban migration has led to the massive expansion of many urban centres in Nigeria. This rapid expansion is adversely affecting environment even in the rural areas through deforestation due to the increasing demand for fuelwood. In many rural communities fuel wood is used for cooking largely because the cost of kerosene and cooking gas is beyond the reach of many rural dwellers.

The study reveals that environmental impact is more severe on the northern verge of the rainforest where charcoal production has led to disappearance of many species of valuable hardwoods resulting in savanna encroachment, migration of wild animals as well as high rate of nomadic in-migration to the area [10].

Due to the problem associated with the high price of domestic fuels, gas and kerosene, in the recent years, the rate of adoption of charcoal as alternative fuel by different categories of people had increased (11). Although coal has been mined since 1915 at Udi, near Enugu, the coal is not of high quality. For some forty years it was used on the Nigerian railways, but diesel locomotives burning oil have replaced most of the coal burning engines.

Charcoal production was found to be considerably profitable, with high rate of return to investment (RORI) of about 0.75 (75%) within a short period of production, it is also less capital intensive. As charcoal production continues much debate has been generated as to whether the economic benefits

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of charcoal production worth the environmental consequences that trail its production [12, 13]. Environmentalist most of the times often focus on carbon, not on the myriad of other adverse effects of coal as a source of cooking fuel.

The method of production is purely traditional and labour intensive [14]. Tree logs are arranged into a heap, covered with sand and grasses and fired for about 48-72 hours to form charcoal, then harvested and bagged. A heap of 7.8m^3 by volume of tree could yield 800kg of lump charcoal. The average cost of producing a 50kg bag of charcoal is ($1.00) and the average selling price ($4.00). The high rate of return on investment (RORI) encourages many youths in the forest region to engage in charcoal production without consideration for the adverse effects of deforestation.

Mean change indices (MCI) of preferred trees for charcoal making reveal that hard woods are mostly at the verge of extinction in the following order of preference Anogeissus leiocapus 49%, Afzellin Africana 46%, Nanclea diderrichii 41%, Vitellaria paradoxum 37%. Some of the soft woods have also been destroyed during the production stages of charcoal.

Lumbering which involves cutting of trees, for timber is also very rampant in the rainforest belt of Oluwa, J3 and J4 forest reserve areas. The lumberjacks sometimes operated illegally in connivance with the forest guards who are supposed to protect the forests. During the process of removing the logs from the interior of the forest, several young trees are cut in order to construct temporary roads for the trucks and Lorries. As a result, thousands of 'yet to mature' trees are wasted and the tracks created subsequently become channels for gully erosion [15].

Consequences of Deforestation

Deforestation, watershed degradation and eroding practices can exacerbate flood-drought cycles. Deteriorating conditions in rural areas can give added impetus to rural-urban migration, placing additional pressures on the urban environments. This is part of a process known as urbanization of poverty.

The study shows that the drier land of Oyo state where charcoal production is extensively practice witness high rate of savanna encroachment leading to migration of wildlife southward. The area also witness high rate of the influx of Fulani herdsmen who migrated from the northern part of the country. Overgrazing on the remnants of the forest has further deteriorated the forest leading to a serious desert encroachment.

The study also showed that charcoal production increases the level of most soil chemical properties, and that such increase diminishes with an increasing distance from the centre of production site. Excessive deforestation in the area has reduced evapotranspiration and there was less binding of the soil by plant roots. The increase in rain splash and the absence of root systems allows easy removal of the soil by wind and water.

Apart from the increase in stream sedimentation, there is rapid increase in surface runoff leading to annual flooding in the downstream urban centres such as Abeokuta and coastal cities especially Lagos Metropolis.

The scenario described above could be classified is a micro view of the challenges at lower spatial resolution when juxtaposed with the global experience and other parts of Africa in particular. However, the Nigerian rainforest has been undergoing critical decimation in terms of deforestation and continuous degradation of the forest ecosystem on the long run will exacerbate the problem of global warming.

CONCLUSIONS

The cost of environmental degradation through recent spate of deforestation in Nigeria is enormous and as such requires concerted effort and cooperation of all stakeholders. The type of economic activity that does not destroy what it sets out to explore has come to be known as sustainable. Thus, it is a kind of development that meets present needs without compromising the prospects of future generations. Only 5 percent of the destroyed vegetation can be returned to some kind of economic development such as agriculture and wildlife habitat.

The Federal Government of Nigeria launched the tree planting campaign with the slogan "cut one plant two" in the early 1990s but the campaign has not been sustained. There is however an urgent need for education and orientation of the people for them to support government efforts towards conservation of our forests for future use.

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To keep sufficient trees for future need of timber, and also to guard our soils and rivers, some forest reserves must be kept. Useful trees may still be cut when ready or mature, but new ones must always be planted in their place. Some trees should also be kept on farms for shade, leaves and compost. Environments at risk can be protected in various ways. At the most extremes, human activities and access can be totally banned or extremely limited such as the case of National Parks.

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